Original Article

Comparative analysis of goal achievement during rehabilitation for older and younger adults with spinal cord injury

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Objective: To evaluate rehabilitation outcome in a representative sample of older and younger SCI patients.

Design: Case series, consecutive sample, survey.

Setting: Tertiary care, spinal cord injury unit (National Spinal Injuries Centre), Stoke Mandeville Hospital.

Participants: One hundred and forty-seven male and 45 female newly injured in-patients (consisting of 152 younger adults, age range = 16 to 54, and 40 older adults, age range = 55 to 85) admitted between 1995 and 1999.

Intervention: All patients were actively participating in a comprehensive, multidisciplinary Goal Planning and Needs Assessment rehabilitation programme.

Main outcome measure: The Needs Assessment Checklist. Specifically designed and developed for the spinal cord injured population, this clinical assessment tool provides a way of assessing and ensuring that rehabilitation programmes are geared toward each patient's individual needs, providing the patient with the skills appropriate to their level of lesion. As part of ongoing psychometric analyses of the Needs Assessment Checklist, internal consistency reliability coefficients are reported for this measure.

Results: The type and cause of injury for the older adult group in this study was comparable with previous research. Older adults' rehabilitation gains were comparable to those of the younger age group. Younger adults were more mobile initially after their injury. However, when the two groups were matched for injury characteristics etc. the only differences in final outcome between older and younger adults were in skin management ability. Both groups showed significant improvements in all areas of need in the period between mobilisation and entering the pre-discharge ward.

Conclusion: These results highlight important considerations for the rehabilitation of older adults and emphasise the need for active, individually tailored rehabilitation programmes. There are specific areas of need (i.e. skin management) where older adults do not achieve comparable levels of independence. Special attention needs to be paid to the problems presented by SCI older adults and efforts should be made to better prepare rehabilitation professionals to adapt to age specific differences.

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Introduction

Spinal cord injury (SCI) has traditionally been defined as a condition of youth. Model Systems epidemiological data indicated that SCI occurs most frequently in younger adults between the ages of 16 and 30, with the most common age being 19.[1] However, the number of older adults sustaining SCI has risen, representing a substantial and growing proportion of the SCI population.[2] Research suggests that between 6 and 20% of all SCI's are sustained by individuals aged 60 years or over.[1,3]

Older adults with SCI (defined as 55 years and older) have a lower survival rate following their injury than younger adults.[4,5] There are also notable differences between older and younger adults in the occurrence of secondary complications following SCI. The greater risk of developing several conditions, including myocardial infarction, hypertension, diabetes, pressure sores, and the increased requirement

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for mechanical ventilatory support have all been associated with acquiring a SCI later in life.[5,8] Additionally, the cause of death in SCI persons also appears to be age related, with respiratory complications being more common in older adults, while subsequent injuries and suicides are more common in younger adults.[6,7] Susceptibility to illness is one of the many consequences of ageing. However, the evidence is equivocal. Roth, Lovell, Heinemann, Lee and Yarkony[9] report no differences in the frequency of complications following SCI or the requirement for mechanical ventilation between older and younger adult age groups. Furthermore, Krause,[10] in a study to investigate ageing after SCI, found that acquiring a SCI at an older age was associated with the reduced risk of developing several conditions.

Declining function is a problem faced by all ageing individuals. Additionally, psychological changes with age, alterations in living situation and family structure, and the potential depletion of social and economic resources also naturally occur. Furthermore, sustaining a SCI has the potential to further complicate the ageing process. Physical changes of ageing in individuals with SCI are often accompanied by changes in life satisfaction, perceived well being and the degree of community integration.[11] Ageing may magnify issues of dependency as needs, abilities, and the limitations of the individual change over time. A change in the level of independence is one component that appears to accompany the ageing process and has been shown to be consistently related to reports of increases in stress, depression, and declining quality of life both in the general population and in individuals with SCI.[12] However, although functional decline is an inevitable consequence, research suggests that a decline in psychological wellbeing is not. Despite the many reports of increasing depression with age there is evidence that perceived quality of life is not necessarily worse for older adults, even those with chronic illness.[13] Additionally, older individuals may have developed expectations that are more commensurate with adaptation to illness than younger individuals and may be more able to cope with life stresses.[13]

Elevated mortality and morbidity rates amongst older adults with SCI have helped propagate the view that older adults may benefit less from rehabilitation, underestimating older adult's rehabilitation potential, and resulting in the inferior service provision for this subgroup of the SCI population. However, to accurately evaluate the rehabilitation gains of individuals' it is necessary to examine more proximal indicators of outcome than mortality and general morbidity. Kiwerski,[4] using measures of ambulation and wheelchair independence, concluded that the older patients had a smaller chance of significant functional recovery. Burns, Golding, Rolle, Graziani and Ditunno[14] also found that recovery of ambulation was significantly reduced if the patient was aged 50 or older when injured.

Subbarao, Nemchausky, Niekelaki, Fruin, Gratzer[15] using a more comprehensive set of rehabilitation outcome measures, suggested that older patients were more likely to have bowel incontinence and use a Foley catheter. Additionally, lower wheelchair independence was reported among older patients with injuries below the level of C8. However, older adults with injuries above the level of C8 were actually more wheelchair independent than younger adults. The older group in this study consisted of a higher proportion of tetraplegia and incomplete injuries, suggesting that this effect may be partially attributable to the injury characteristics of the two groups, however, interpretation of these results is difficult.

DeVivo et al,[5] using regression analysis to control for sex, race, neurological level, extent of lesion and use of mechanical ventilation, reported that older adults were less independent in self-care activities. This was reflected by a greater utilisation of hired attendant care. Cifu, Seel, Kreutzer and McKinley[16] also reported greater levels of dependency among older adult groups. Using the American Spinal Injuries Association Motor Index (ASIA Motor Index) and the Functional Independence Measure (FIM), more improvement was found in a matched younger adult group than in the older adult group between admission and discharge. Interestingly, one study using 708 SCI patients stated that age had little influence on rehabilitation outcome.[17] Additionally Cifu, Seel, Kreutzer and McKinley;[16] Subbarao, Nemchausky, Niekelski, Fruin and Gratzer;[15] and Kiwerski[4] have all been careful to note that a comprehensive approach to acute care and SCI rehabilitation enables significant progress to be achieved with older adults. In a study investigating rehabilitation staff perceptions of the characteristics of geriatric rehabilitation patients, Nicholas, Rybarczyk, Meyer, Lacey, Haut, and Kemp,[18] report that the recognised differences between younger and older adults were perceived by treating professionals as variables that require more skill and effort. These results suggest that the training of rehabilitation professionals needs to better prepare individuals from all disciplines to adapt to age-specific differences.

The standardised functional rating scales used in some of the above studies represent a compromise between having sufficient length to reliably and validly cover all domains of interest, appropriately sampling the item universe, and the need for a relatively short scale that is practical to use.[19] Consequently, many of the usual targets for treatment and rehabilitation are omitted and a smaller number of higher order concepts are focussed on. Existing measures including the Functional Independence Measure (FIM),[20] the Barthel Index[21] and measures of handicap such as the CHART[22] are used extensively in health and rehabilitation care and have established psychometric reliability and validity. However, they have been proven to be more relevant for assessing population samples and their brevity inhibits a fine grain analysis

of progress. The FIM is noted for possessing significant floor and ceiling effects and being insensitive to small changes in performance,[23] which has little relevance to individual, week-to-week, patient-centred rehabilitation planning. Consequently, the scale score may not capture all the change resulting from the rehabilitation programme, and may additionally include some material that is unrelated to the targets of the individual patient's rehabilitation programme. Such scales (excluding the CHART) have a dominant emphasis on physical restoration, and consequently, individuals with high cervical and complete lesions are particularly misrepresented by these outcome measures. An individual with a SCI may require the use of a wheelchair for the rest of their life and regard themselves as completely independent. However, this person would obtain a lower FIM score of 'modified independence' due to the use of a device. Furthermore, due to an individual's injury level and completeness, aspects of the FIM may be irrelevant. Using the FIM, non-applicable items are scored as 1, limiting the individual's potential to score highly on this scale because of item relevance. These scales do not state what level of functioning the treatment is expected to produce and, consequently, treatment efficacy for the individual patient cannot be measured accurately.

The limitations of these standardised scales are particularly salient in the assessment of minority groups with atypical needs. Additionally, with the increased survivorship of individuals with high level SCI and the tendency for these people to live in their community, rather than institutional settings, many people with a SCI require personal assistance, disposable medical supplies (e.g. catheters and leg bags), assistive technologies and environmental control devices. SCI individuals also require knowledge about how to prevent pressure sores, avoid skin insults and manage their skin. In order to understand and enhance the quality of life, and other health related outcomes of people with SCI, rehabilitation outcome measures must be modified to reflect the experiences and needs of the SCI individual.[24] SCI population characteristics are changing and the modification of assessment should also acknowledge that the evaluation of individuals based on their functional independence is an assessment limitation. Keith and Lipsey[25] emphasise that it is important for rehabilitation medicine to move beyond its preoccupation with scales that rate physical tasks. For individual's with high cervical lesions it is the ability to articulate one's own needs and achieve 'verbal independence' in areas of knowledge such as dressing the lower body, and managing the bladder and bowels that is the primary rehabilitation goal. According to the International Classification of Function and Disability,[26] disablement should be conceptualised as a dynamic process. Individuals should not be described as static, or progressing along a unidirectional disablement process. Assessment measures should also reflect the rehabilitation process, assessing

the individual on skills appropriate to their functional capabilities and personal goals, facilitating their full reintegration into the community.

Older adults represent an important subgroup of the spinal cord injured population whose outcome is likely to be misrepresented by scores from population-focused scales. There are several factors that affect this. Firstly, older adults are likely to have been more physically impaired prior to injury than younger adults.[5,9,15] Therefore, the same level of physical functioning post-injury should not be anticipated – as they are with population focused scales when comparing rehabilitation gain or rehabilitation outcome in older and younger adults with SCI. Secondly, injury characteristics differ between younger and older adults with older adults being more likely to sustain an incomplete cervical lesion than younger individuals[4,5,9] and injury characteristics seriously affect the degree of physical independence following injury. Due to the heterogeneous nature of SCI's there is great diversity in what would constitute a successful outcome within the spinal cord injured population. Consequently, Smith *et al*[19] advocate that the assessment of individuals should be patient-centred, examining patient's achievement in relation to their rehabilitation goals, providing clinically meaningful information.

The Needs Assessment Checklist (NAC)[27] is a clinical assessment tool that has been used at the National Spinal Injuries Centre (NSIC) as part of an integrated Needs Assessment and Goal Planning program, and was originally developed in order to manage problems of institutionalisation and increase patient engagement. Behavioural engagement in comprehensive rehabilitation has been found to be the best predictor of post-discharge physical and psychological status,[28] however patient adherence to treatment has remained a problem across the healthcare domain. Slade[29] suggests that an assessment tool developed in everyday clinical use should go beyond symptomatology and the behaviour observed by professionals, and incorporate the client's perceptions. McGrath, Marks, and Davis[30] found that by taking client's wishes into account, compliance is significantly increased.

The Needs Assessment Programme is a structured rehabilitation framework that provides a way of assessing and ensuring that rehabilitation programmes are geared toward each patient's individual needs. Research shows that there is a discrepancy between what actually occurs and what people believe occurs during rehabilitation.[27] Treatment Theory[25] attempts to account for the processes that occur in the transformation from input to outcome. It begins by defining problems for a specific population and specifies the critical input, the important steps to produce the desired effects, the mode of delivery, and the expected outcome. This has been the framework for the Needs Assessment Programme.

Principally, the Needs Assessment specifies the problems for new spinal cord injured patients, operationalises the critical inputs required for rehabi-

litation, and measures the effects of those inputs, their relationship to other mediating variables, and the expected outcome. The NAC is used as part of the programme to determine which needs are most salient for each individual patient. The results from this are then used to define specific behavioural goals during multidisciplinary Goal Planning meetings. The NAC is administered again 6 weeks prior to discharge to provide information for the reappraisal of rehabilitation efforts. The NAC is thereby directly linked to the process that transforms received therapy into improved health outcome, and because it has been developed to facilitate the goal planning process, each score reflects small attainable improvements. In contrast, Keith and Lipsey[24] note that most rehabilitation research focuses exclusively on patient characteristics without reference to what is available in the treatment domain.

The checklist consists of 199 behavioural indicators of rehabilitation outcome, covering nine core areas of need for a patient with a SCI (activities of daily living, skin management, bladder management, bowel management, mobility, equipment, community preparation, discharge co-ordination, psychological issues). Patient's rate themselves between 0 – 3, or Not Applicable. Independence is only evaluated in those goals that are relevant to the patient, according to the method of bladder management or care requirements. Consequently, scores are adjusted according to the patient's goals and needs. Questions that are 'not applicable' are scored as 'fully achieved' because they are irrelevant to the individual's treatment and rehabilitation. An example of this adaptive rehabilitation assessment is provided in Figure 1.

Based on some of the criticisms of existing outcome measures outlined above, the NAC assesses both physical and verbal independence. No distinction is made between verbal and physical independence, enabling each patient to have the potential to achieve 100% independence. Individuals who have sustained high cervical lesions who may be unable to physically perform for example, pressure relief while sitting, may be assessed according to their verbal independence. In

this task a score of verbal independence would require the individual to feel confident that they could independently request pressure relief at the appropriate intervals and instruct another person/carer to perform this task correctly. It is paramount that individuals with a high level of physical disability are able to exert control and articulate their own needs. Even when assistance from others is necessary, this can be incorporated into an individual's life in such a way that optimises independence for the person with SCI.[11] The measurement of verbal independence makes the NAC more sensitive to gains that are of relevance to the individual patient and nurtures greater patient independence. Additionally, it is important for such a rehabilitation measure to assess competency in the ability to sustain community living and facilitate social reintegration.

Reliability and validity analyses of the NAC are currently being undertaken. At present, the measure has yielded high internal consistency (coefficients are given below, see Measures), and is undergoing test/retest reliability and concurrent validity analyses. Clinical audit on the NAC has also revealed promising results. In a review of 82 patients examining rehabilitation outcome at the NSIC, Kennedy and Hamilton[26] found that the Needs Assessment and Goal Planning Programme was successful in establishing greater client independence, whether assessed at a verbal or physical level. A 78% goal achievement rate was recorded and patients maintained their level of independence, in the majority of areas, 2 years after discharge.[30] The needs of this patient group are significantly lower after rehabilitation.[26] The Needs Assessment Programme has also been shown to be successful in terms of its usefulness to staff, and in focusing the different team members on specific goals.[31] Sixty per cent of patients felt that their achievements had been good or very good, while 80% felt that this system was beneficial to their rehabilitation.[32] MacLeod and MacLeod[30] found that their goal planning system, based on the Needs Assessment Programme at the NSIC, was helpful in enabling patients to become more informed about the consequences of their injury and promote a sense of
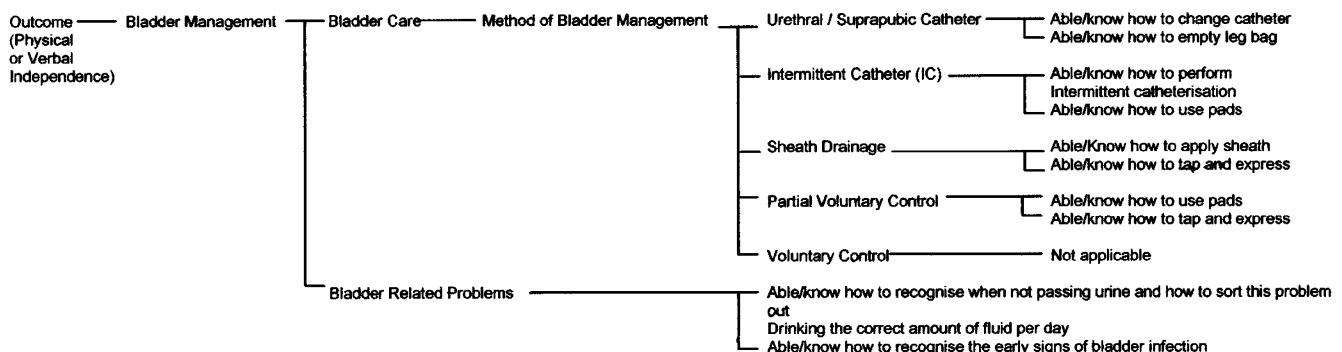

Figure 1 Outcome analysis of the needs assessment checklist: bladder management

control over rehabilitation. Staff also found that goal planning was useful and helped with accountability and improved communication.

The aim of this study is to evaluate rehabilitation outcome in a representative sample of older and younger SCI patients from the NSIC, using the NAC. This study will examine whether the belief that older adults do not gain as much from the rehabilitation process as younger adults is substantiated, when a more SCI population specific and adaptive outcome measure is used.

Method

Participants

Data was collected from 200 patients with newly acquired traumatic and non-traumatic SCI, admitted to the NSIC between 1995 and 1999. Patients for whom the time difference between their Needs Assessments lay more than three standard deviations from the mean, or was less than 4 weeks were excluded from analyses as such differences between assessments were considered anomalous. Eight individuals were excluded from the study on the basis of these criteria leaving a sample of 192 patients (147 males and 45 females). Age was defined by age at the first NAC. The mean age of this sample was 40.7 (SD = 16.5). Older patients with SCI were defined as individuals 55 years of age or older. By this age the majority of pre-existing medical conditions (diabetes mellitus, heart disease, hypertension) have developed, and such conditions influence rehabilitation outcomes significantly.[15] The same age criterion has been used previously in other studies.[9,15,16] Forty (20.8%) subjects were aged 55 – 85, the mean age of this group was 66.3 years (SD = 7.4). One hundred and fifty-two (79.2%) subjects were aged 16 – 54, the mean age of this group was 34.0 years (SD = 10.6). Of the 173 participants (within this sample) for whom injury characteristics data was available, complete paraplegic injuries accounted for 34% of injuries, incomplete paraplegic injuries 22%, complete tetraplegic injuries 21%, and incomplete tetraplegic injuries 23%. Amongst the 172 patients for whom aetiological data was available, the most common cause of injury was road traffic accidents (38%), followed by falls (23%), medical conditions (20%), sports injuries (13%), assault (3%) and others (4%).

In order to control for group injury characteristics a second participant group was created and younger and older adult groups were matched according to injury level and completeness, and sex. This group consisted of 78 participants extracted from the original unmatched cohort. Both younger and older adult groups consisted of individuals with complete tetraplegia (18%), incomplete tetraplegia (14%), complete paraplegia (16%), and incomplete paraplegia (11%). This group also consisted of 56 males and 20 females.

Measures

Rehabilitation outcome was measured using the Needs Assessment Checklist[26] (NAC). The checklist has nine specific rehabilitation domains each with key behavioural indicators: activities of daily living (31 indicators); skin management (14 indicators); bladder management (13 indicators); bowel management (10 indicators); mobility (20 indicators); wheelchair and equipment (33 indicators); community preparation (33 indicators); discharge co-ordination (27 indicators); and psychological issues (19 indicators). The patient rates his/her level of independence for each item. Where a patient's injury makes physical independence impossible the patient's level of verbal independence (his or her ability to adequately instruct someone else to carry out the activity in question) is rated. Each item receives a score from 0 to 3: 0 = completely dependent; 1 = mostly dependent; 2 = moderately dependent; or 3 = completely independent. Item scores are summed and a percentage 'to be achieved' calculated for each of the nine areas of need. NAC subscale scores are graphically presented and used in subsequent Goal Planning meetings to establish rehabilitation priorities and the setting of explicit behavioural targets.

For the purposes of this study, internal consistency reliability coefficients were computed (using data from 316 patient's first Needs Assessment) for each of the NAC subscales: activities of daily living (alpha = 0.9467); skin management (alpha = 0.8478); bladder management (alpha = 0.7753); bowel management (alpha = 0.8741); mobility (alpha = 0.8358); wheelchair and equipment (alpha = 0.9239); community preparation (alpha = 0.7146); discharge co-ordination (alpha = 0.8855); psychological issues (alpha = 0.6729). To establish the internal consistency of the NAC a correlation coefficient of 0.7 and above was required. Such strong alpha coefficients demonstrate that the NAC possesses a high degree of internal consistency, especially regarding the limited number of items within some subscales.

Procedure

Data were retrieved from the Needs Assessment Database. During hospitalisation all patients participated in the Needs Assessment and Goal Planning Programme, a comprehensive multidisciplinary rehabilitation framework. Patients completed the NAC at two time intervals: within 2 weeks of mobilisation and 6 weeks prior to discharge. Length of time between assessments varied from 4 – 52 weeks, with a mean of 13.4 (SD = 7.4). A representative from the multidisciplinary team (such as the patient's Physiotherapist, Occupation Therapist, Named Nurse, Discharge Co-ordinator or Psychologist) administered the NAC. Assessments were scored by the Department of Clinical Psychology. Between assessments fortnightly Goal Planning meetings took place during which the patient together with relevant members of the rehabilitation team decided upon appropriate goals and targets.

Statistical analyses

Differences in demographic and injury characteristics between the younger and older adult group To identify whether significant differences in demographic and injury characteristics exist between younger and older adult groups, frequencies of gender, injury type, completeness of injury and cause were calculated. Chi-square was performed in order to compare these group frequencies. Non-parametric statistics were employed, as tests to establish the psychometric properties of the NAC have not, as yet, been completed. In view of the large number of tests employed, a relatively stringent significance level was also used throughout the study ($P<0.01$). In order to determine whether older adults took longer to make comparable rehabilitation gains to that of younger adults, a Mann–Whitney U test was performed comparing the number of weeks between assessment of younger and older adults.

Independence levels at first and second Needs Assessment Mean 'percentage to be achieved' of all NAC subscales for both first and second Needs Assessment were calculated for both younger and older adult groups and compared using the Mann–Whitney U (2-tailed) test. Analyses were also conducted using a smaller sample, matched for injury level, completeness and sex. This procedure was employed in order to eliminate injury level and completeness as a significant confound within the measurement of the goal achievement and rehabilitation gains of younger and older adults.

Achievement between first and second Needs Assessment Wilcoxon Signed Rank Tests were performed in order to identify significant decreases in 'percentage to be achieved' for the whole sample in all nine subscales, between the first and second Needs Assessment. Analysis of younger and older adult mean achievement, using both matched and unmatched samples was performed using the Mann–Whitney U test. Mann–Whitney U was also employed to determine whether there was a significant difference in first and second Needs Assessment scores when participants were classified according to sex, completeness of injury, level of injury, and sex. Additionally, a Kruskal–Wallis test was performed to determine whether cause of injury affected rehabilitation gain.

Results

Differences in demographics and injury characteristics between the younger and the older adult group
The younger adult group consisted of 76.3% males and 23.7% females, compared to 77.5% and 22.5% in the older adult group. The male to female ratio was not significantly different between the two groups. A greater proportion of the older group had tetraplegia (54%) than was the case for the younger group (42%). This difference was not significant. There was a significantly greater proportion of incomplete injuries in the older group (65%) than in the younger group (39%; $\chi^2 = 7.896$, df = 1, $P = 0.005$). Figure 2 presents the proportion of complete and incomplete paraplegia and tetraplegia in both groups.

The proportion of injuries in the younger group caused by road traffic accidents (43%) was double that found in the older group (19%), and the proportion of sports injuries in the younger group (15%) was more than twice that found in the older group (6%). The younger group had less than half the amount of medical injuries (15%) than the older group (39%) and a lower proportion of falls (21% compared to 31%).

In order to account for such a wide rehabilitation time frame and make inferences about the differences between the two groups other than the period of hospitalisation, the number of weeks between younger and older adult's first and second NAC was compared. The mean time between first and second Needs Assessments was 13.1 weeks for the younger group and 14.7 weeks in the older group. This difference was not significant.

Independence levels
Independence levels at first and second Needs Assessment The mean 'percentage to be achieved' score for the whole sample at the first NAC was 51%, this decreased by 29%, to 22% by the second NAC. In an analysis of subscale scores at the first Needs Assessment, a Mann–Whitney U (2-tailed) test determined that the mobility needs of older adults were significantly higher than the younger group (U = 2105, $n = 192$, $P < 0.005$), however, community 'to be achieved' scores were significantly lower amongst the older group (U = 2235, $n = 192$, $P = 0.01$). At the second Needs Assessment 'to be achieved' scores in the areas of skin management (U = 2234, $n = 192$, $P < 0.01$), bladder management (U = 2221, $n = 192$, $P < 0.01$),
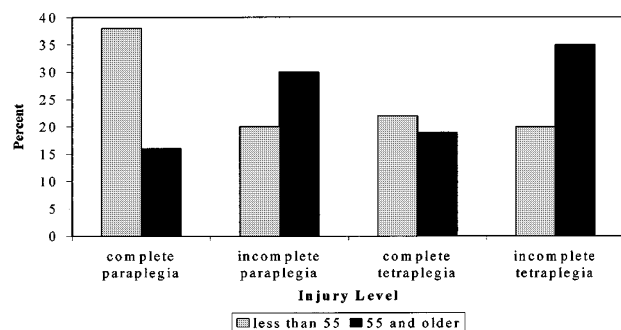
**Figure 2** Comparison of injury level in younger ($n = 136$) and older ($n = 37$) adult groups

bowel management (U = 2099, *n* = 192, *P* < 0.05) and mobility (U = 2190, *n* = 192, *P* < 0.01) were significantly higher in the older adult group compared with younger adults.

To determine whether the injury characteristics contributed to the significant differences identified between younger and older adults at the first and second Needs Assessments, analyses were also conducted using a smaller sample matched for injury type (paraplegia/tetraplegia), and completeness. A Wilcoxon signed rank test indicated that the younger adult group had a significantly higher level of independence than the older group in the area of skin management at the second Needs Assessment (z = −2.8, *P* < 0.01). Analysis of the matched sample showed no significant differences in the other eight areas of need at the second Needs Assessment or at, suggesting that significant differences identified between the unmatched sample in the other eight areas of needs may be related to the different injury characteristics of the younger and older adult groups.

Achievement between first and second Needs Assessment Wilcoxon Signed Rank Tests for the whole sample showed significant decreases in 'percentage to be achieved' scores in all nine areas of need (8.7 < Z < 11.6, *n* = 192, *P* < 0.0001) between first and second Needs Assessments. The greatest decreases occurred in the areas of bowel management (39.4%) and mobility (36.6%). The smallest decreases occurred in the area of psychological issues (11.6%). The areas that showed the greatest degree of improvement generally had higher 'to be achieved' scores at the first Needs Assessment and therefore had a greater scope for improvement, and *vice versa*.

Analysis, using both matched and unmatched samples, was performed comparing the mean achievement scores of younger and older adults in all nine subscales. Mann–Whitney U analysis found no significant differences between these age groups. The areas showing greatest improvement were bowel management (41.1%) in the younger adult group, and mobility (36.3%) in the older adult group (Figure 3).

A Mann–Whitney U test was performed to determine if there were any significant differences between first and second Needs Assessment scores when participants were classified according to sex, completeness of injury and level of injury, regardless of age. Individuals with complete lesions showed greater improvement in bowel management than those with incomplete lesions (U = 2703, *P* < 0.005) and tetraplegia was associated with a greater level of improvement than paraplegia in skin management (U = 2686, *P* < 0.005). No other significant results were found. A Kruskal–Wallis (2-tailed) test was employed to examine possible relationships between cause of injury and rehabilitation gain, however, no significant differences were found.
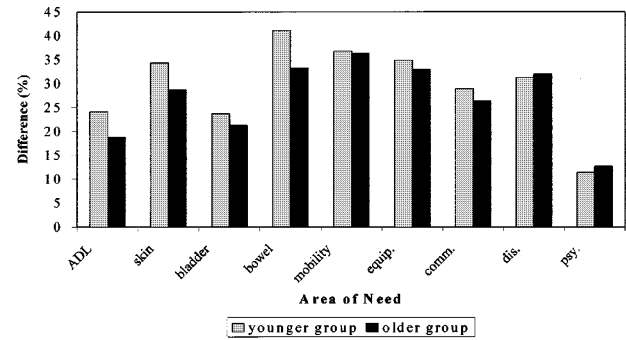
Figure 3 Different scores in all areas of need for the younger (*n* = 152) and older groups (*n* = 40)

Discussion

Older adults' rehabilitation gains were similar to those of the younger age group. Differences in final outcome emerged between the older and younger adults, but both groups showed significant improvements in all areas of need in the period between mobilisation and entering the pre-discharge ward. Improvement, as well as being statistically significant, was also large in magnitude. On average more than half of what needed to be achieved at the time of the first Needs Assessment was accomplished by the second Needs Assessment. Such consistently large improvement suggests that most patients made clinically significant gains during their rehabilitation.

Rehabilitation gain did not differ between the groups when they were matched for injury characteristics and sex nor when the whole-unmatched sample was used. Post-mobilisation the older group had less community needs than the younger group. The younger group was more mobile initially than the older group and showed better final outcome for skin, bladder, bowel and mobility in the unmatched sample and skin in the matched sample. Analysis of the matched sample showed no significant differences in the other eight areas of need at the second Needs Assessment or at the first Needs Assessment. This result suggests that injury characteristics, rather than age, has more impact on an individual's rehabilitation potential and accounts for many of the differences between the two age groups. When matched for injury level and completeness there is very little difference between the rehabilitation gains of younger and older adults with a SCI.

The results show some consistency with the previous literature where older adults have been found to be less independent in some areas of functioning at discharge. The differences found in this study were less pronounced than those previously found. This may be attributable to this studies' use of an adaptive, goal-orientated outcome measure as opposed to a population orientated one. Previous studies have tended to examine final outcome, so it is encouraging

that when treatment gains were examined in this study older adults appeared to show a similar level of improvement to younger patients. Generally, it would appear that older adults benefit greatly from rehabilitation and can obtain a high level of independence at discharge, however, there are specific areas of need (ie skin management) where their level of independence is lower than younger adults. This finding supports Nicholas *et al*'s[18] recommendation that treating professionals from all disciplines need to be better prepared to adapt to age specific differences. Special attention needs to be paid to the problems presented by SCI older adults.

Reduced functional independence is an inevitable consequence of ageing, therefore a lower functional outcome for older adults was anticipated. Comparisons with the non-injured population's functional performance for each age group would be useful for interpreting outcome. Alternatively retrospective information regarding pre-injury levels of functioning would provide an indication of the potential for independence.

Generally the characteristics of the sample reflected those of previous studies, with a greater proportion of older adults sustaining incomplete and cervical injuries than was the case for younger patients. Our sample did however have a lower proportion of women amongst the older adult group than has previously been found.[9,15,16]

Matching older patients with younger ones on the basis of injury characteristics and sex should have minimised confounds. The categories used for level of injury (tetraplegia/paraplegia) and completeness (complete/incomplete) were however, fairly simplistic. The use of Frankel or Asia grading to match participants would also have provided more detailed analysis.

The validity of using verbal independence as an outcome measure could be questioned. However, clinical experience indicates that verbal independence is of great relevance to those individuals for whom physical independence is not possible and for this reason its use as an outcome measure would appear justified. Furthermore, as Keith and Lipsey[24] have suggested that physical assessment alone insufficiently predicts health status. Findings from other studies measuring physical independence exclusively have shown that older adults can make highly significant gains in functional ability, so it is important that, whilst acknowledging the role of verbal independence, improvement in physical functioning is not limited in older adults by expectations of poor physical outcome and an over reliance on verbal independence. The NAC has proved a useful tool in facilitating an effective multidisciplinary rehabilitation process, regardless of age.

Overall, it would appear that when the individual's rehabilitation goals are considered older patients can make significant rehabilitation gains but that in specific areas older adults' final level of independence is lower than that of younger adults. These findings

attest to the utility of adaptive, goal-orientated rehabilitation programmes and emphasise the need to develop a greater understanding of the specific needs of older patients with a SCI. Other minority groups whose needs are often underrepresented in research include individuals who can walk and women. If health outcomes for minority groups are to be maximised then their specific needs require examination. Furthermore, adaptable rehabilitation processes need to be developed to allow these findings to inform treatment practices and ensure that each individual's needs are comprehensively addressed.

Acknowledgements

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